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A FIELD TEST OF STABILIZED PYRETHRINS AGAINST THE WESTERN HEMLOCK LOOPER MT. BAKER NATIONAL FOREST 1969

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
PACIFIC NORTHWEST REGION
DIVISION OF TIMBER MANAGEMENT

March 1970

A FIELD TEST OF STABILIZED PYRETHRINS AGAINST THE WESTERN HEMLOCK LOOPER MT. BAKER NATIONAL FOREST, 1969

by

Jack Mounts, Forester
Timber Management

Leon F. Pettinger, Entomologist
Timber Management

Robert Phillips, Fishery Biologist
Range and Wildlife Management

U.S. Department of Agriculture
Forest Service - Pacific Northwest Region
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INTRODUCTION

The purpose of the test was to determine the effectiveness of a new stabilized form of pyrethrins in controlling the western hemlock looper under field conditions.

In laboratory tests at the Pacific Southwest Forest and Range Experiment Station, the pyrethrins were found to be the most effective insecticide tested against hemlock looper larvae collected from a current outbreak near Mt. Baker, Washington. In earlier tests, looper larvae from this infestation were especially tolerant of DDT, the insecticide most commonly used in the past to control looper outbreaks.

Because of their high toxicity to the hemlock looper and other lepidopterous defoliators, the pyrethrin compounds may be desirable materials to use against a number of forest insect pests. They are harmless to warm-blooded animals and should be relatively safe insecticides to use in the forest environment. Previous formulations of pyrethrins deteriorated quickly in the presence of sunlight and, thus, were generally ineffective for outdoor use.

Forest Service scientists at the Pacific Southwest Forest and Range Experiment Station have developed a stabilizer to overcome this problem. It was necessary to field test this stabilized formulation in a natural stand before further development work could be carried out. Because the hemlock looper is extremely sensitive to pyrethrins in the laboratory, it should be an excellent insect for bioassay of the stabilized material in the field.

The field test was conducted jointly by the Pacific Northwest Forest and Range Experiment Station and Region 6 of the U.S. Forest Service. The Kenya Pyrethrum Company of Newark, New Jersey furnished the insecticide and financing of certain aspects of the study.

The field test was carried out in two phases. The first phase was done by the Pacific Northwest Forest and Range Experiment Station and consisted of spraying known looper populations on individual trees. The second phase was done by Region 6 of the Forest Service, and consisted of spraying 145 acres of a looper-infested natural stand of western hemlock.

Results of Phase I of the test are being reported separately by the Pacific Northwest Forest and Range Experiment Station in an office report.[1/]

Phase II.--Pilot test of stabilized pyrethrins against the western hemlock looper

Results from the individual tree tests indicated that stabilized pyrethrins are effective against the looper under field conditions. The next phase of the operation was to determine if stabilized pyrethrins were effective against the looper under forest conditions. This was carried out by spraying a 145-acre infestation in mature timber on Kindy Ridge.

A. Operational Aspects.--Operational aspects of the stabilized pyrethrin test covered both Phase I and II as a matter of convenience and economy.

1. Equipment.--Because of the small size of the test area and the necessity for accurate application, the insecticide was applied with a Bell 47G-3 helicopter, using commercial spray equipment.

In order to attain the smallest particle size possible with commercial equipment, 19 size 80015 Tee Jet nozzles were used with 45 p.s.i. of pressure on the spray pump. Mixing of the pyrethrin formulation was done using a standard 1/2-inch drill with a long-stemmed paint mixer. This was inserted into each drum just before loading on the helicopter.

A hand-operated barrel pump was used to transfer spray material from the barrels to the helicopter spray tank.

Portable radios were used to maintain communications between Phase I area and the helispot. Phase II personnel were located at the helispot overlooking the Phase II area and were able to give instructions to the pilot between spray runs.

[1/]Mason, Richard R. Controlled field test of stabilized pyrethrins against the western hemlock looper. Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, Corvallis, Oregon. Office Report, December 5, 1969.

High-visibility fluorescent cloth was used to mark the boundaries of the Phase I spray area and the helispot location. No marking was necessary on the Phase II area, since it was completely surrounded by clearcuts and/or roads.

2. Application.--Spray was applied by helicopter on July 10, 1969. The helicopter flew 50-foot swaths at about 55 miles per hour covering approximately 6 acres per minute of flying time. Spray was applied from an altitude of between 30 and 50 feet above the timber.

The formulation of pyrethrins contained 0.2 pounds of active ingredient per gallon of spray material. Application was at 1/2 gallon per acre, giving approximately 0.1 pounds of active ingredient per acre. Total area sprayed was 6 acres in Phase I and 145 acres in Phase II.

3. Weather.--The weather was intermittently rainy during spray application periods. Several times the helicopter had to wait for the next run until the rain stopped or until the clouds moved away from the spray areas. Spray was not actually applied during the rain, but there was intermittent rain between spray runs. Since the weather forecast was for several days of rain and some personnel important to the project were unable to remain longer, the decision was made by the Project Director to attempt to finish before the rain started.

Wind readings were taken periodically during spraying and no spraying was done with winds of greater than 5 miles per hour. During most of the project, winds were less than 3 miles per hour.

4. Safety.--All safety precautions for spray projects were observed and no accidents of any kind were attributed to the project.

5. Project Costs.--The Kenya Pyrethrum Company furnished the spray formulation, including transportation, at no cost to the Government. Other costs of the project, excluding personnel and equipment costs of Phase I, which were financed by the Kenya Pyrethrum Company, are as follows:

Helicopter ferry time	
3 hours at $105.00.....	$ 315.00
Helicopter spray time	
151 acres at $3.75/acre.....	$ 566.25
Transportation	
R-6, I&DC personnel.....	$ 222.50
Per diem	
R-6, I&DC personnel.....	$ 542.00
Salaries	
R-6,I&DC personnel.....	$4,086.00
Total	$5,731.75

6. Coordination With Other Federal and State Agencies.--Contacts were made during the planning stages of the project with the following agencies:

U.S. Fish and Wildlife Service
U.S. Public Health Service
U.S. Agricultural Research Service
U.S. National Park Service
U.S. Weather Bureau
Federal Water Pollution Control Administration
Washington State Department of Game
Washington State Department of Fisheries
Washington State Department of Natural Resources
Washington State Pollution Control Commission
University of Washington

Monitoring of effects on fish and aquatic insects was done by fishery biologists from the State of Washington Department of Fisheries, U.S. Fish and Wildlife Service, and the U.S. Forest Service.

7. Personnel - Phase II

Forest Service	Duties
Jack Mounts	Project Director
Robert Dewitz	Photographer
David McComb	Entomologist
Leon Pettinger	Project Entomologist
Robert Phillips	Fishery Biologist
Peter Orr	Supervisory Entomologist
Stephen Spaulding	Insect Checker
Kenneth VanderMey	Insect Checker
John Wortendyke	Equipment and Supply

Cooperators	Duties
Warren Shanks U.S. Fish and Wildlife Service	Fishery Biologist
Russell Orrell Washington Department of Fisheries	Fishery Biologist
Tom Bogaard Kenya Pyrethrum Company	General Manager

Contract Personnel	Duties
Paul Mitchell Emco Helicopters, Inc.	Owner and Chief Pilot

8. Surveillance.--A companion test to the spray project was made to measure the impact of the pyrethrin spray on aquatic habitat. This test was carried out cooperatively by the Washington State Department of Fisheries, U.S. Fish and Wildlife Service, and Forest Service.2/

A test stream was chosen from one of two streams flowing through the 145-acre test area. The test stream was shallow and precipitous with a rocky bottom and probably contained no fish, since the average depth was only .25 feet and average width about 4 feet.

A 1/4-acre pond was also included in the test. Coho fingerlings in live cages were placed in both the pond and the test stream as well as in Kindy Creek, which was used as a control.

Drift samples were taken in the test stream and in the Kindy Creek Control, and a count of aquatic insects, chiefly mayflies and caddis flies, was made on a number of stones about 6 inches in diameter. The stones were chosen at random and were not resampled.

Results.--All but one coho fingerling came through the test apparently in good health. Death of the one coho was attributed to handling or causes other than the pyrethrins.

The major effect of the pyrethrin spray appeared to be on the aquatic insect population. Sampling consisted of 5-minute drift samples both before and after treatment. Each of the two pretreatment samples weighed 0.15 grams. A post-treatment sample taken at 3:40 p.m., 40 minutes after the spray reached the test stream, weighed 54.9 grams, composed entirely of dead and dying aquatic insects. The drift of aquatics declined rapidly during the remainder of the day. A sample taken at 7:00 p.m. weighed 15.8 grams, which is more than 100 times greater than the pretreatment drift rate. This sample contained 22 tadpoles, representing 39 percent by weight of the drift sample. The reason for the presence of the tadpoles is unknown, but was apparently linked to the pyrethrins.

Two drift samples were taken on July 11 and showed the rate of drifting aquatic insects to be continuing to decrease. The last sample taken on July 11 at 10:00 a.m. weighed 2.3 grams. This was 15 times that of the pretreatment drift rate. A final sample was taken on July 14 and showed less than 0.01 grams of insects.

2/Phillips, R. W. The Effect of Pyrethrins on Live-Caged Fish, and on Free-Living Aquatic Insects, in a Field Test on Mt. Baker National Forest, Washington.1970. (In preparation for publication, Pacific NW. Region, U.S. Forest Serv., Portland, Oreg.)

The drift of aquatic insects in Kindy Creek control stream in the pretreatment and early treatment periods showed less than 0.01 grams in all samples.

No attempt was made to determine the effect of the spraying on aquatic insects in the pond. Mosquitos and mayflies were flying above the pond on July 11, indicating little, if any, mortality had occurred.

Discussion.--An estimate of maximum concentration of pyrethrins in the test stream indicated about 150 micrograms per liter at time of maximum spray effect. This is a concentration 15 times greater than the 24 hour LC_{50} for stoneflies reported by Bridges and Cope (Ca.1965). Because of dilution, the time of exposure to this concentration was short.

The coho juveniles held in live cages indicated the concentration of pyrethrins used in the test was not lethal to fish. However, because of the fine mesh in the netting of the live cages, drifting aquatic insects were excluded from the cages. Had the fish had access to the drifting insects, they would probably have gorged themselves on them and possibly have received a much greater dosage rate.

The effect of the pyrethrin spray on the aquatic insect population was extremely heavy. A comparison of standing crop of aquatic insects as revealed from the stone counts showed only 1/30 as many mayflies and caddis flies remaining after treatment. Because of the heavy mortality to aquatic insects which provide much of the food for trout and other salmonids, pyrethrins in forest insect control projects should be used with care. It may be necessary to provide buffer strips along watercourses or devise other methods to protect streams from spray drift.

Figure 1.--Spray area

Figure 2.--Helispot

Figure 3.--Hemlock looper larva

Figure 4.--Mixing insecticide with portable paint mixer before loading in helicopter

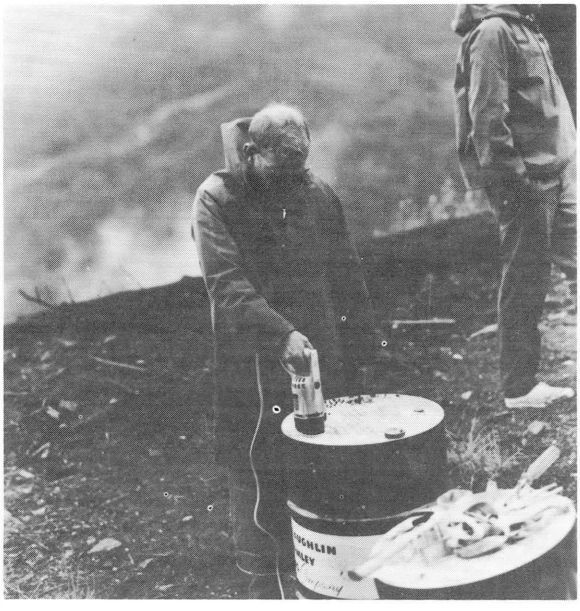

Figure 5.--Loading insecticide into helicopter tank

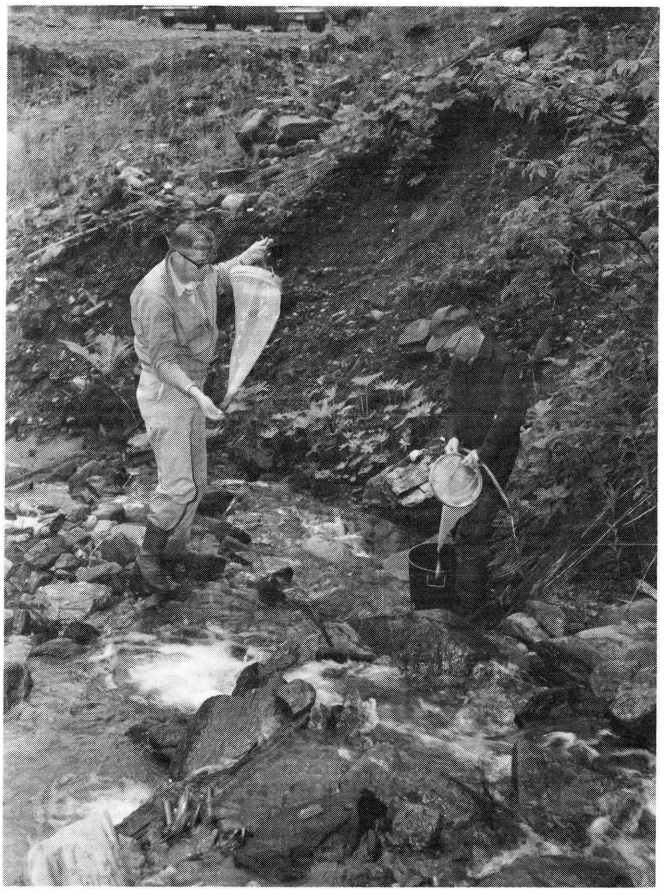

Figure 6.--Gathering aquatic insects for check on mortality from insecticide

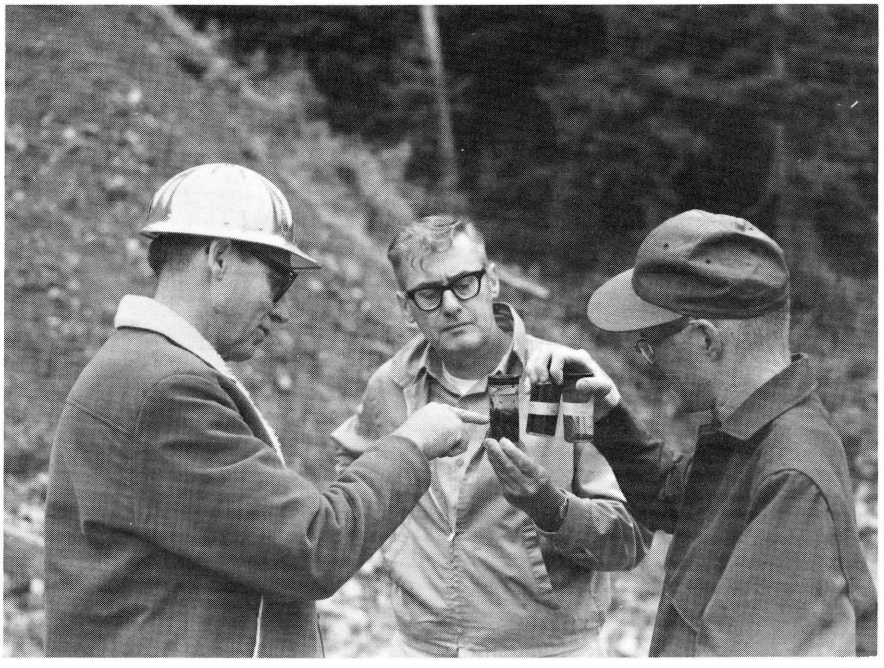

Figure 7.--Heavy aquatic insect mortality after spraying with pyrethrins. Bottle on right shows insects gathered before spraying, that on left, after spraying

B. Biological Phases

1. Prespray and Postspray Larval Sampling.--Looper mortality was determined by sampling the populations 24 hours before spraying and 24 hours after spraying. Ten mortality plots were established in the spray area and one in a nearby unsprayed check area. At each mortality plot in the sprayed area, two 15-inch branches were taken from the midcrown of three trees. At the plot in the unsprayed area, two branches were taken from eight trees. Prespray and postspray sampling methods were the same. In all cases, the sampling was done on understory trees because the height of overstory trees prevented sampling.

2. Frass Drop Collections.--At each mortality plot, 24- by 24-inch muslin bottom trays were placed under dominant and codominant trees to record changes in rate of frass drop. It was hoped that a change in drop rate could be correlated with a change in population number. Frass drop was recorded during the 24-hour period before spraying and the 24-hour period after spraying.

3. Fall of Larvae Affected by Spray.--Dead and moribund larvae found in the frass collection trays were counted during the 24-hour periods before and after spraying. The healthy larvae found in the trays were not counted. A dead larva was one that showed no signs of movement or life, while a moribund larva was one showing abnormal reactions ranging from complete paralysis to only slight erratic movements.

RESULTS

A. Population Changes Between Prespray and Postspray Sampling.--Larval sampling at all ten mortality check plots in the spray area showed an overall population decrease of 63.5 percent (table 1). Looper mortality on individual plots within the spray area varied from a low of 20.0 percent to a high of 86.0 percent. The population on the unsprayed check plot showed an increase from prespray sampling to postspray sampling of 12.5 percent.

Table 1.--Western hemlock looper population before and after spraying with stabilized pyrethrins

Plot No.	Larval Count		Population Change	
	Prespray	Postspray	Increase	Decrease
	- - - Number - - -		- - - Percent - - -	
1	16	9	-	43.7
2	43	6	-	86.0
3	10	8	-	20.0
4	31	8	-	74.2
5	43	17	-	60.5
6	27	16	-	40.7
7	28	10	-	64.3
8	64	21	-	67.2
9	25	8	-	68.0
10	9	5	-	44.4
Total	296	108	-	63.5
Check Plot				
11	48	54	12.5	

Larval Development at Spray Date.--The majority of the looper larvae were in the third and fourth instar of development at the spray date. Development by instars was as follows at the time of spraying: I, less than 1 percent; II, 18.2 percent; III, 48.1 percent; IV, 33.1 percent; V, none.

Frass Drop Collections.--Frass drop collections proved to be an unreliable method of evaluating mortality. Collections varied widely among the 10 mortality check plots. All plots, as well as the unsprayed check plot, showed a reduction in frass between the prespray and the postspray check. Reduction in frass drop varied considerably between plots. The average reduction in frass drop from all 10 mortality check plots was 48.1 percent with a range of 16.6 percent to 75.0 percent from the lowest to the highest. Percent reduction on the unsprayed check plot was 24.1 percent (table 2).

Table 2.--Western hemlock looper frass collections

Plot No.	24-hour Prespray	24-hour Postspray	Percent Reduction
	- - - Grams - - -		
1	0.20	0.15	25.0
2	0.50	0.40	20.0
3	0.30	0.25	16.6
4	0.50	0.30	40.0
5	0.50	0.40	20.0
6	1.15	0.50	56.5
7	0.50	0.20	60.0
8	0.45	0.15	66.6
9	0.70	0.20	71.4
10	0.40	0.10	75.0
Total	5.20	2.65	48.08
Check Plot			
11	2.90	2.20	24.1

Fall of Larvae Affected by Spray.--Dead and moribund larvae in the frass trays showed that the spray reached them. In the 24 hours before spraying, only two dead larvae were found in the frass trays, while in the 24 hours immediately after spraying, dead and dying larvae averaged more than 11 larvae per tray. No dead larvae were found in the trays under the unsprayed check plot trees (table 3).

Table 3.--Collection of pyrethrin-affected looper larvae in 31 frass trays

Plot No.	No. of Trays[1]	Prespray			Postspray		
		Moribund	Dead	Total	Moribund	Dead	Total
		- - - Number - - -					
1	3	0	0	0	0	20	20
2	4	0	0	0	30	78	108
3	3	0	0	0	6	3	9
4	3	0	0	0	0	0	0
5	4	0	1	1	24	23	47
6	3	0	1	1	4	33	37
7	3	0	0	0	2	5	7
8	3	0	0	0	13	21	34
9	3	0	0	0	10	63	73
10	2	0	0	0	3	13	16
Total	31	0	2	2	92	259	351
Average/ tray	0	0	0.064	0.064	2.97	8.35	11.32
Check plot	8	0	0	0	0	0	0

[1]/Tray size 24 by 24 inches

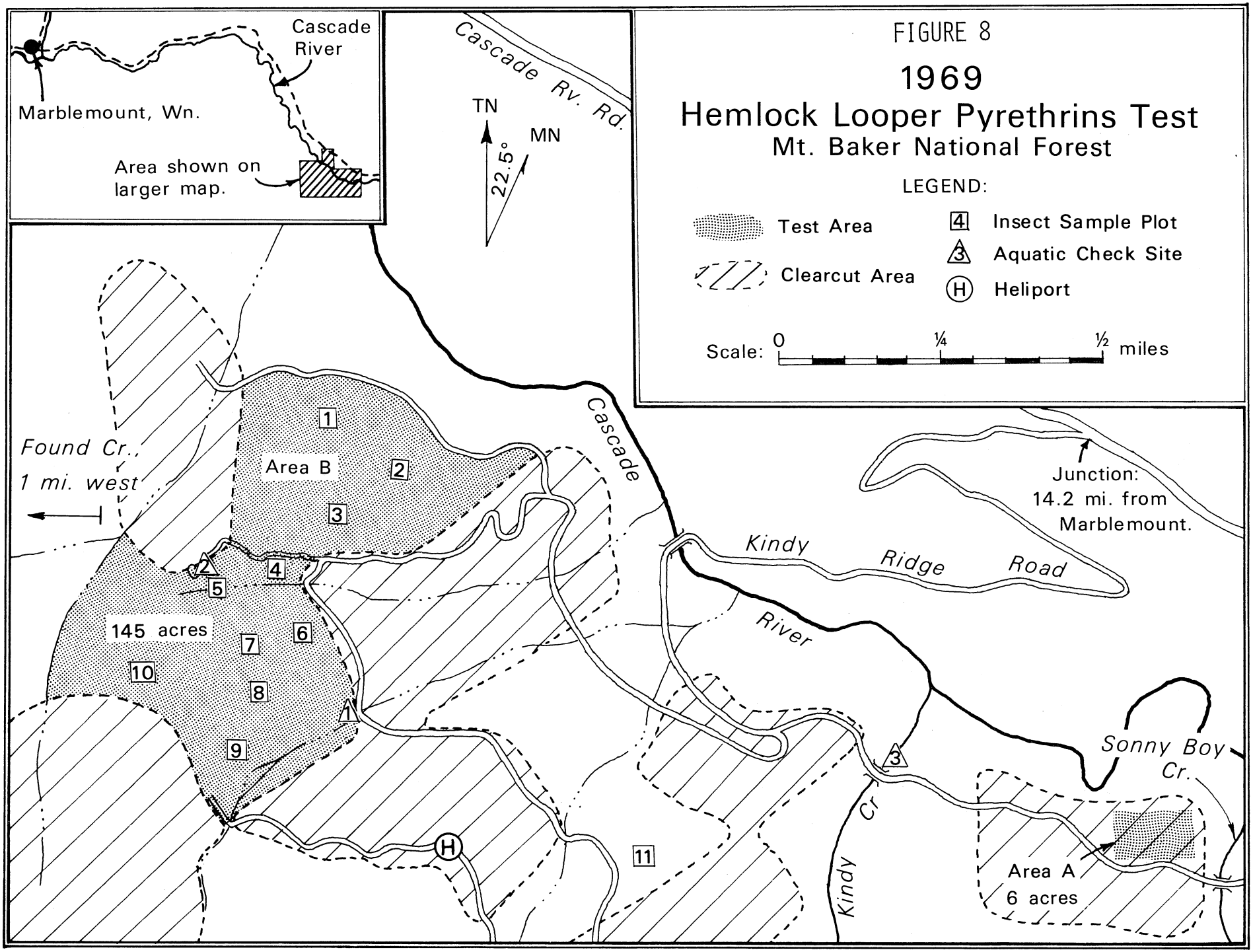
FIGURE 8
1969
Hemlock Looper Pyrethrins Test
Mt. Baker National Forest
LEGEND:
Test Area
Clearcut Area
Insect Sample Plot
Aquatic Check Site
Heliport
Scale: 0 ¼ ½ miles
Cascade River
Marblemount, Wn.
Area shown on larger map.
Cascade Rv. Rd.
TN
MN
22.5°
Found Cr., 1 mi. west
Area B
145 acres
Cascade
Kindy Ridge Road
Junction: 14.2 mi. from Marblemount.
River
Sonny Boy Cr.
Kindy Cr
Area A
6 acres

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